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Bailey et al.

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(54) **COMBINED POWER AND MANAGEMENT MODULE FOR USE IN A RACK-CONFIGURED INFORMATION HANDLING SYSTEM**

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H05K 7/14	(2006.01)
H02J 9/06	(2006.01)
G06F 1/18	(2006.01)

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(58) **Field of Classification Search**

CPC H05K 7/1457; H05K 7/1467; H05K 7/1482; H05K 7/1492; G06F 1/188; G06F 1/189

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,927,974	B2 *	8/2005	Robillard	H05K 7/183 361/679.4
8,570,180	B2 *	10/2013	Ma	G06F 1/181 340/635
8,767,382	B2 *	7/2014	Mori	H05K 7/1492 211/22
8,817,464	B2 *	8/2014	Jau	H05K 7/1492 361/679.48
9,019,707	B2 *	4/2015	Xu	H05K 7/1492 312/223.2
2004/0062002	A1 *	4/2004	Barringer	G06F 1/18 361/679.4
2005/0071689	A1 *	3/2005	Coward	G06F 1/189 713/300
2006/0039108	A1 *	2/2006	Chikusa	G06F 1/20 361/695
2006/0082222	A1 *	4/2006	Pincu	H02J 1/102 307/29
2007/0268634	A1 *	11/2007	Gjerde	H01R 31/02 361/18
2008/0122289	A1 *	5/2008	Best	H05K 7/1457 307/25
2010/0290604	A1 *	11/2010	Wright	H05K 13/0023 379/102.04

(Continued)

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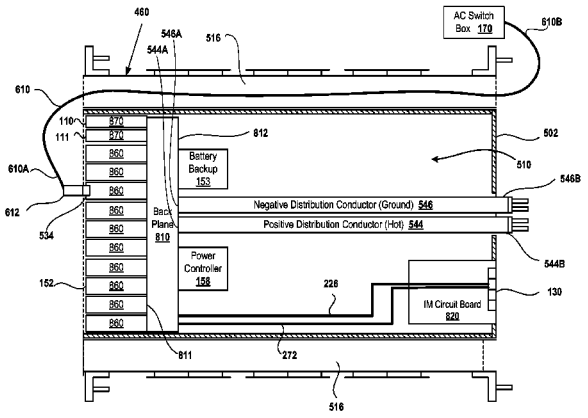
(57) **ABSTRACT**

A scalable power and management module (PMM) includes a chassis configured to be slideably inserted into a power and management bay within a rack. The PMM provides scalable power distribution and rack-level management functions that are shared by several information technology (IT) gear. Several power supply units (PSUs) are mounted in the chassis. The number of PSUs is scalable based on the number of IT gear. A management controller is mounted in the chassis to provide rack-level management of the IT gear and at least one associated block controller within the rack. A power controller is mounted in the chassis and is communicatively coupled to the PSUs and the management controller. The power controller controls power functions of the PMM.

22 Claims, 13 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2011/0154085 A1* 6/2011 Rickard G06F 1/325 713/340
2012/0170175 A1* 7/2012 Silberbauer H05K 7/1432 361/637
2013/0017699 A1* 1/2013 Li G06F 1/188 439/212
2013/0039006 A1* 2/2013 Li H05K 7/20736 361/679.48
2013/0063894 A1* 3/2013 Wang H05K 7/1492 361/692
2013/0077209 A1* 3/2013 Su H05K 7/1492 361/622
2013/0107436 A1* 5/2013 Li H05K 7/1492 361/679.4
2013/0111098 A1* 5/2013 Li G06F 1/188 710/305
2013/0135805 A1* 5/2013 Wang H05K 7/1492 361/679.02
2013/0179718 A1* 7/2013 Jau G06F 1/263 713/340
2013/0198534 A1* 8/2013 Bailey G06F 1/30 713/300
2013/0249286 A1* 9/2013 Hou G06F 1/26 307/18

* cited by examiner

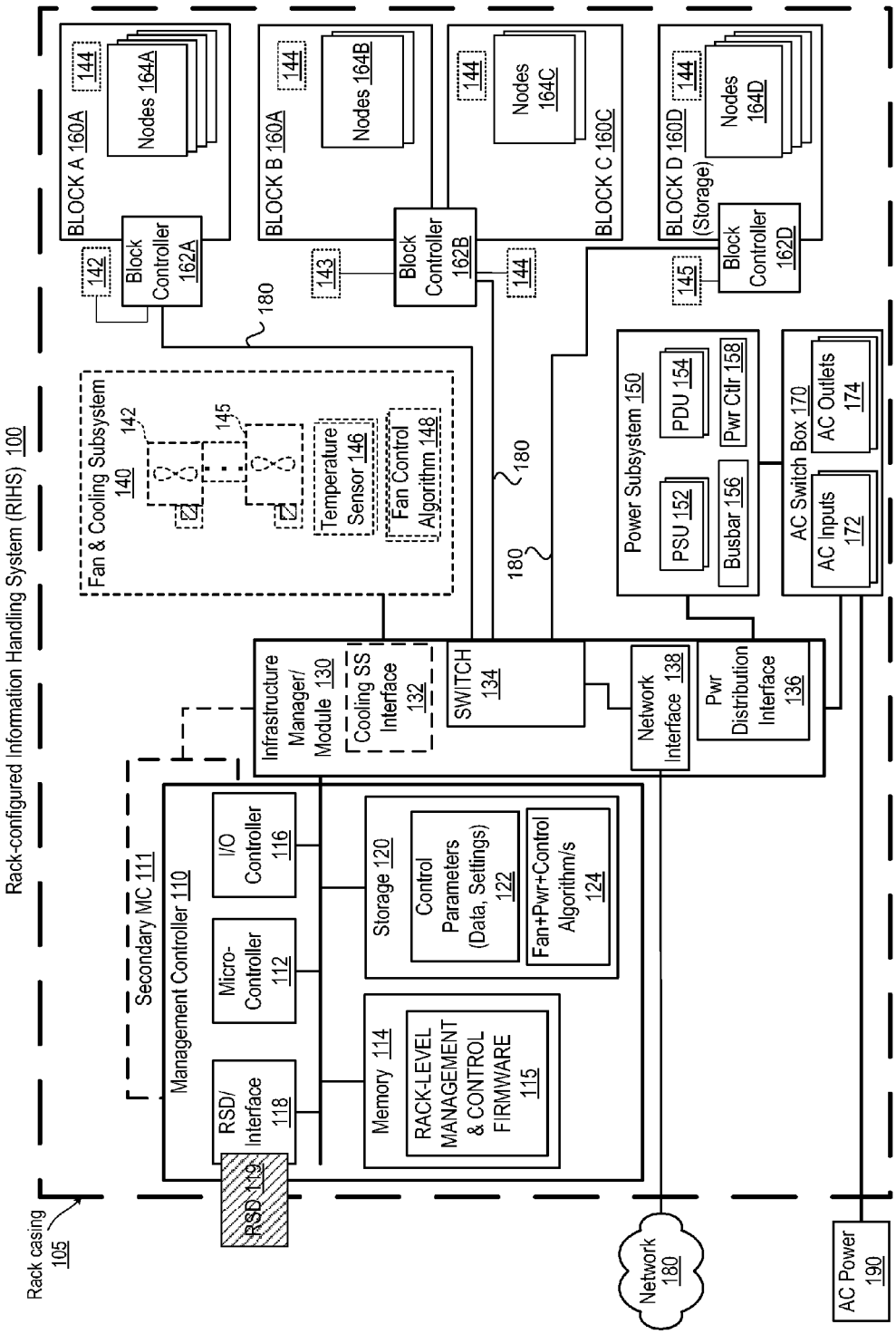

Rack-configured Information Handling System (RIHS) 100
Rack casing 105
BLOCK A 160A
144
Nodes 164A
BLOCK B 160A
144
Nodes 164B
BLOCK C 160C
144
Nodes 164C
BLOCK D 160D (Storage)
144
Nodes 164D
142
Block Controller 162A
143
Block Controller 162B
144
145
Block Controller 162D
180
Fan & Cooling Subsystem 140
142
145
Temperature Sensor 146
Fan Control Algorithm 148
Power Subsystem 150
PDU 154
PSU 152
Busbar 156
Pwr Ctlr 158
AC Switch Box 170
AC Outlets 174
AC Inputs 172
Infrastructure Manager/ Module 130
Cooling SS Interface 132
SWITCH 134
Network Interface 138
Pwr Distribution Interface 136
Secondary MC 111
Management Controller 110
I/O Controller 116
Micro-Controller 112
RSD/ Interface 118
RSD 119
Storage 120
Control Parameters (Data, Settings) 122
Fan+Pwr+Control Algorithm/s 124
Memory 114
RACK-LEVEL MANAGEMENT & CONTROL FIRMWARE 115
Network 180
AC Power 190

FIG. 1

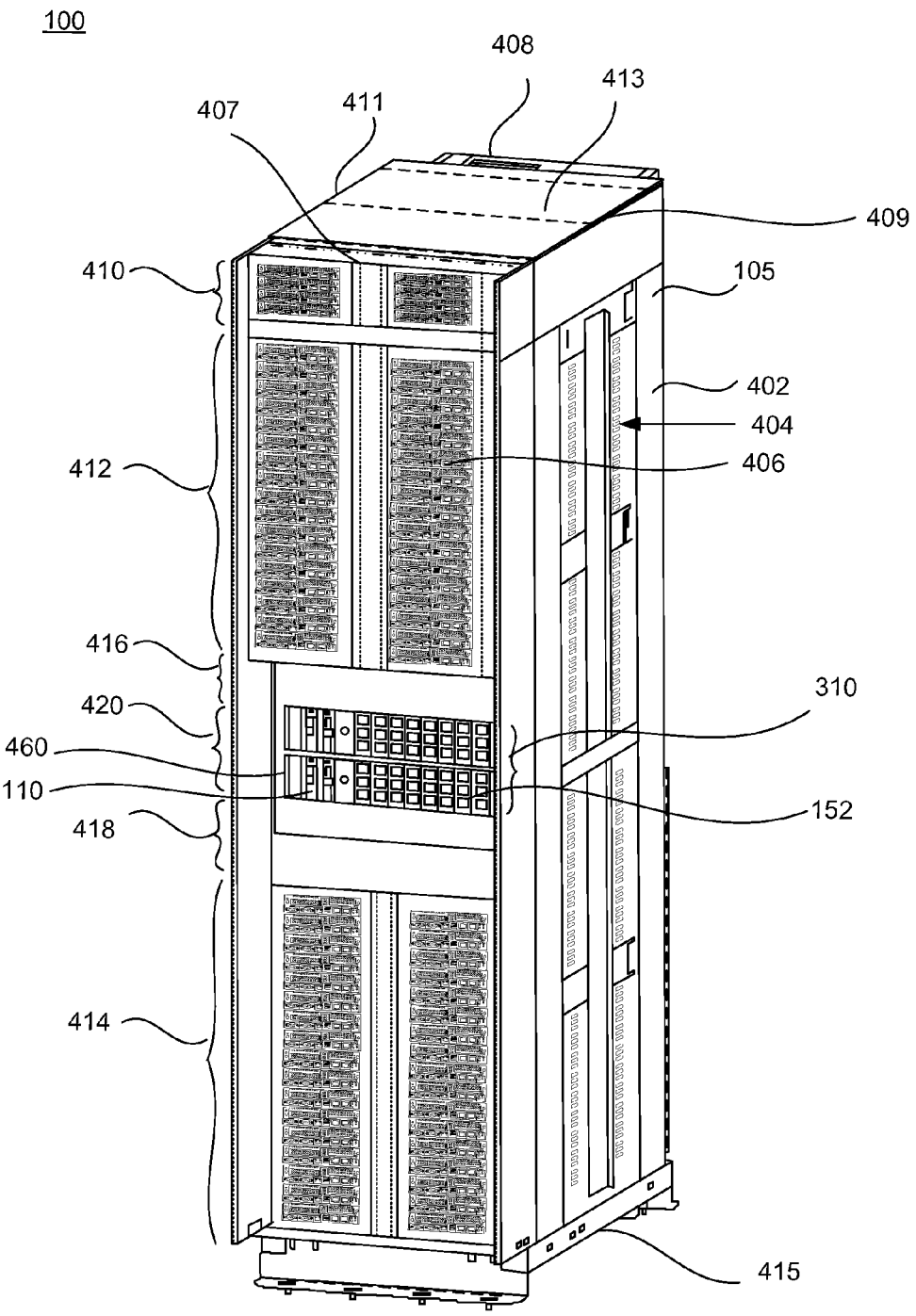
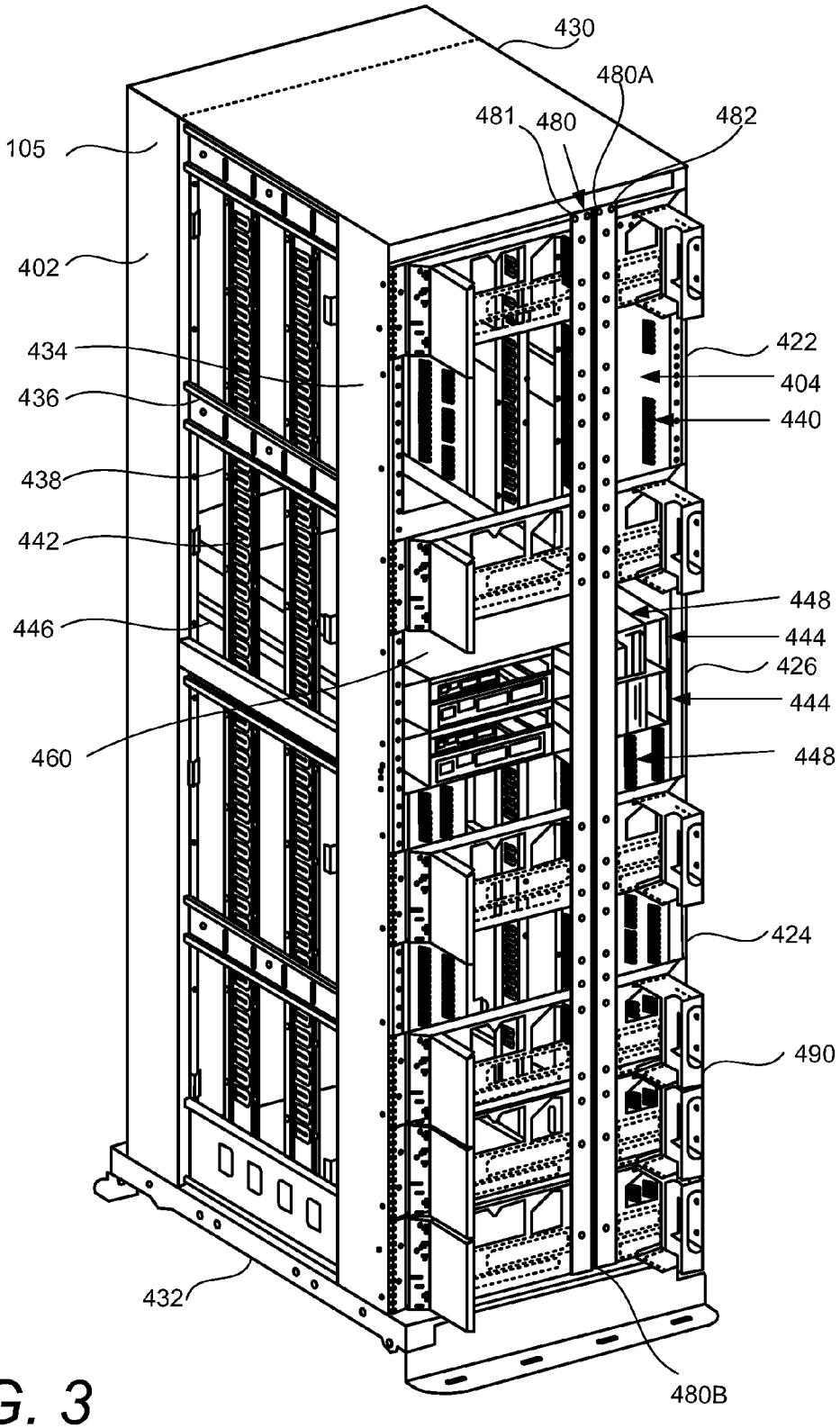

100
408
413
407
411
409
410
105
402
404
406
412
416
420
310
460
110
152
418
414
415

FIG. 2


430
480A
481
480
482
105
402
434
436
438
442
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460
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404
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448
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426
444
448
424
490
432
480B

FIG. 3

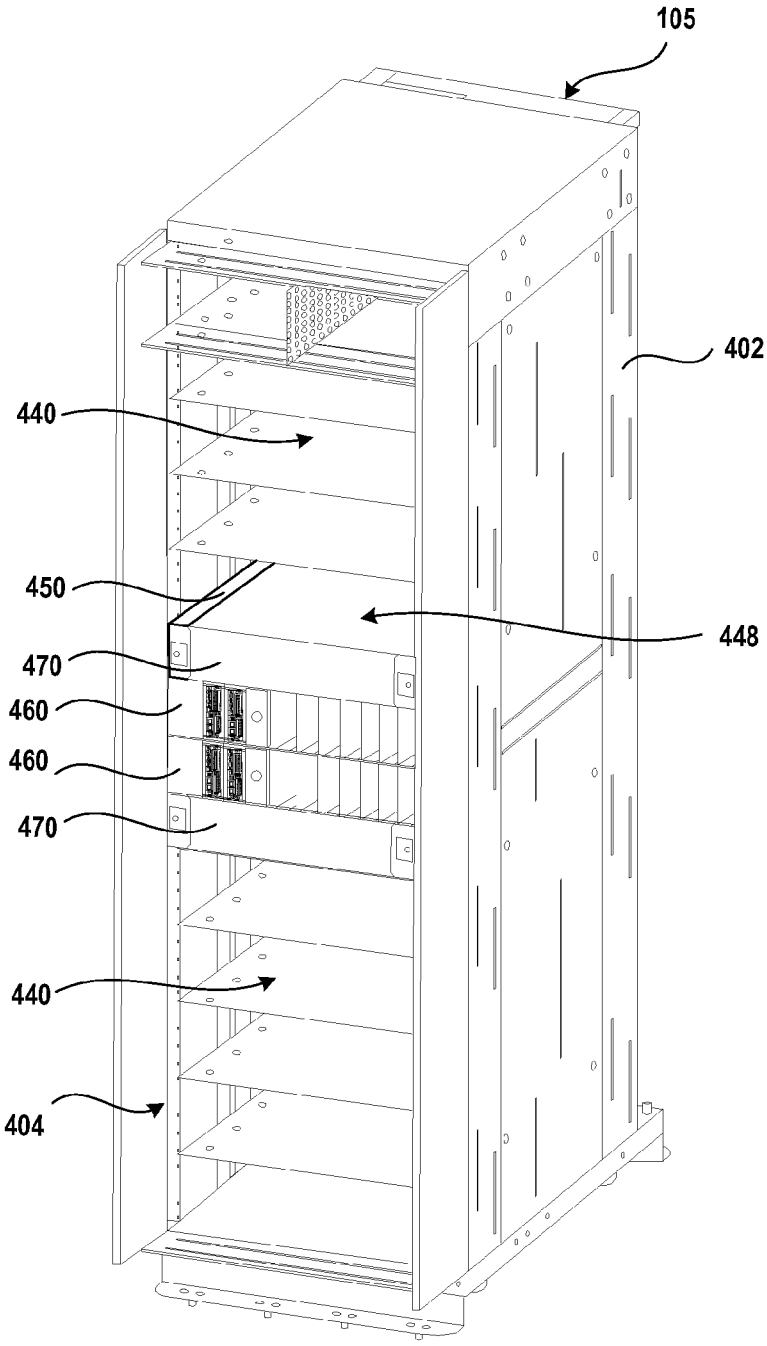


FIG. 4

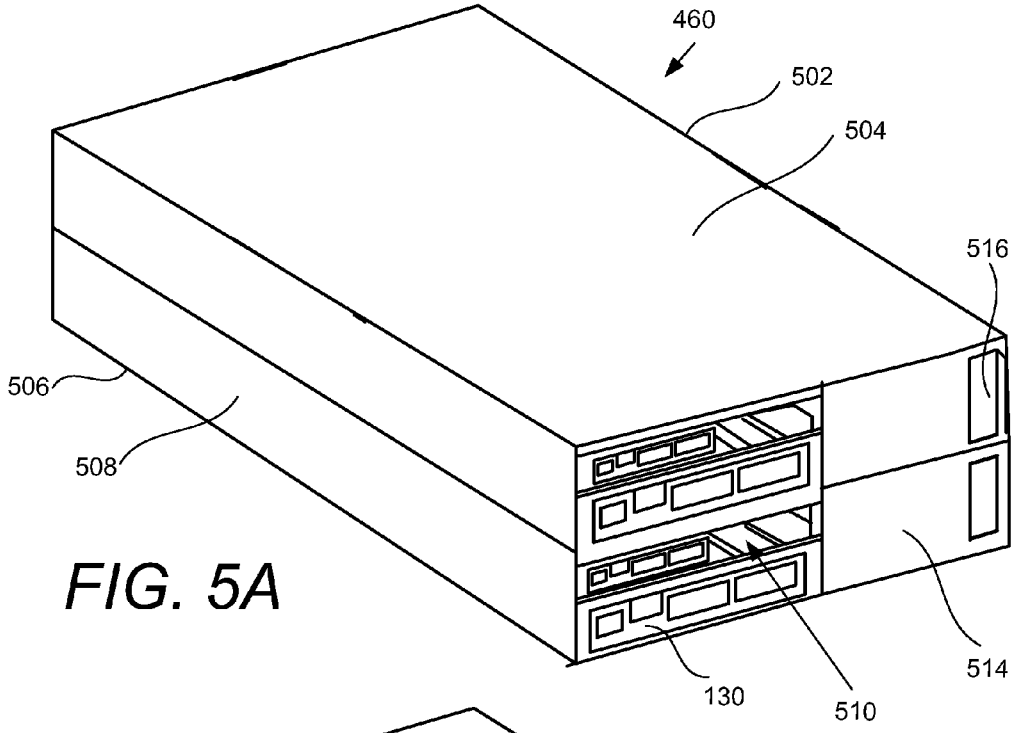


FIG. 5A

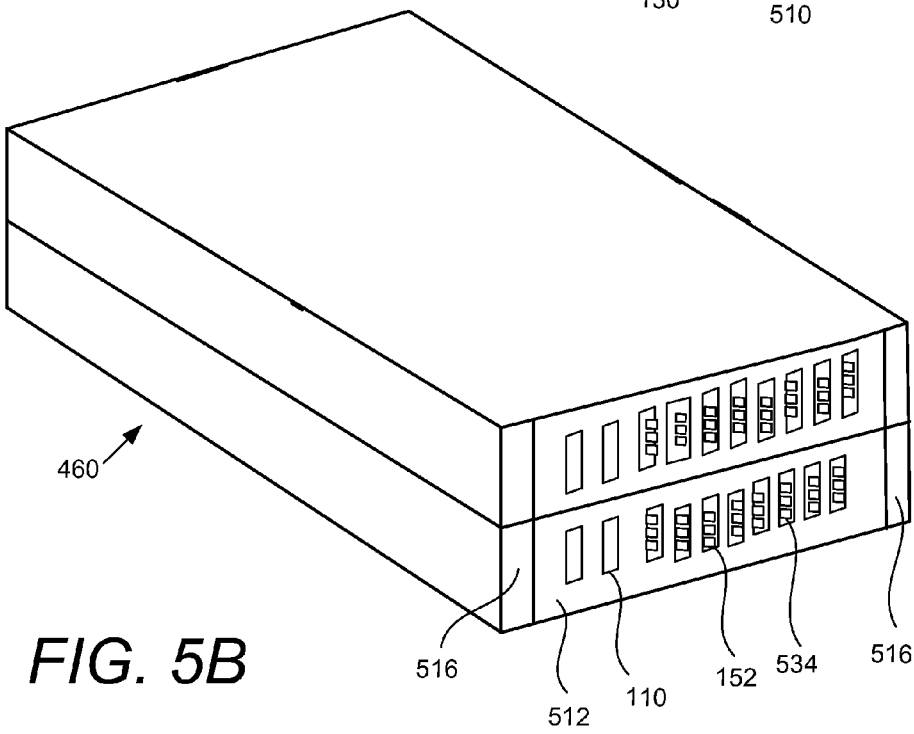


FIG. 5B

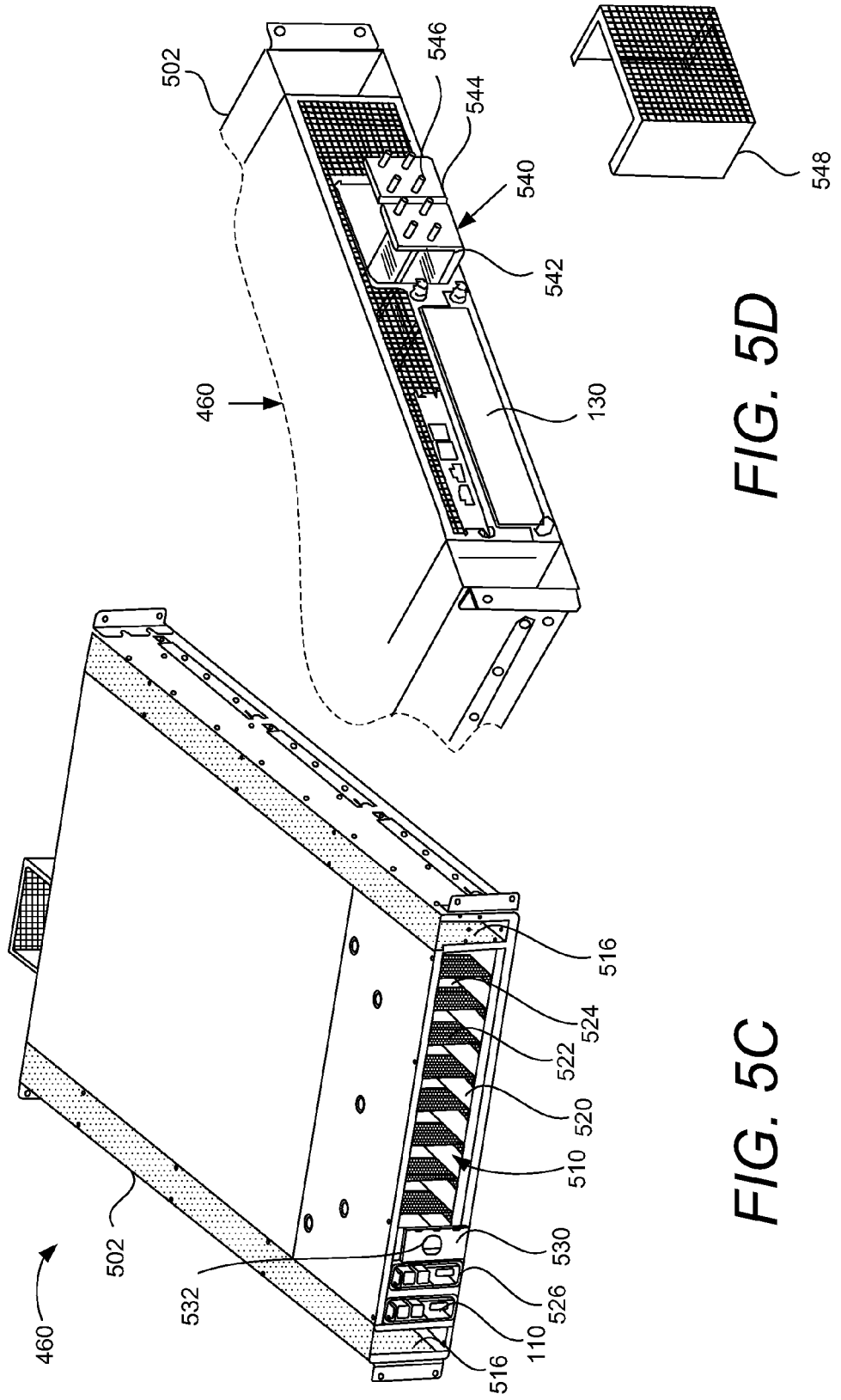

502
546
544
540
542
548
460
130
516
524
522
520
510
530
526
110
532

FIG. 5D

FIG. 5C

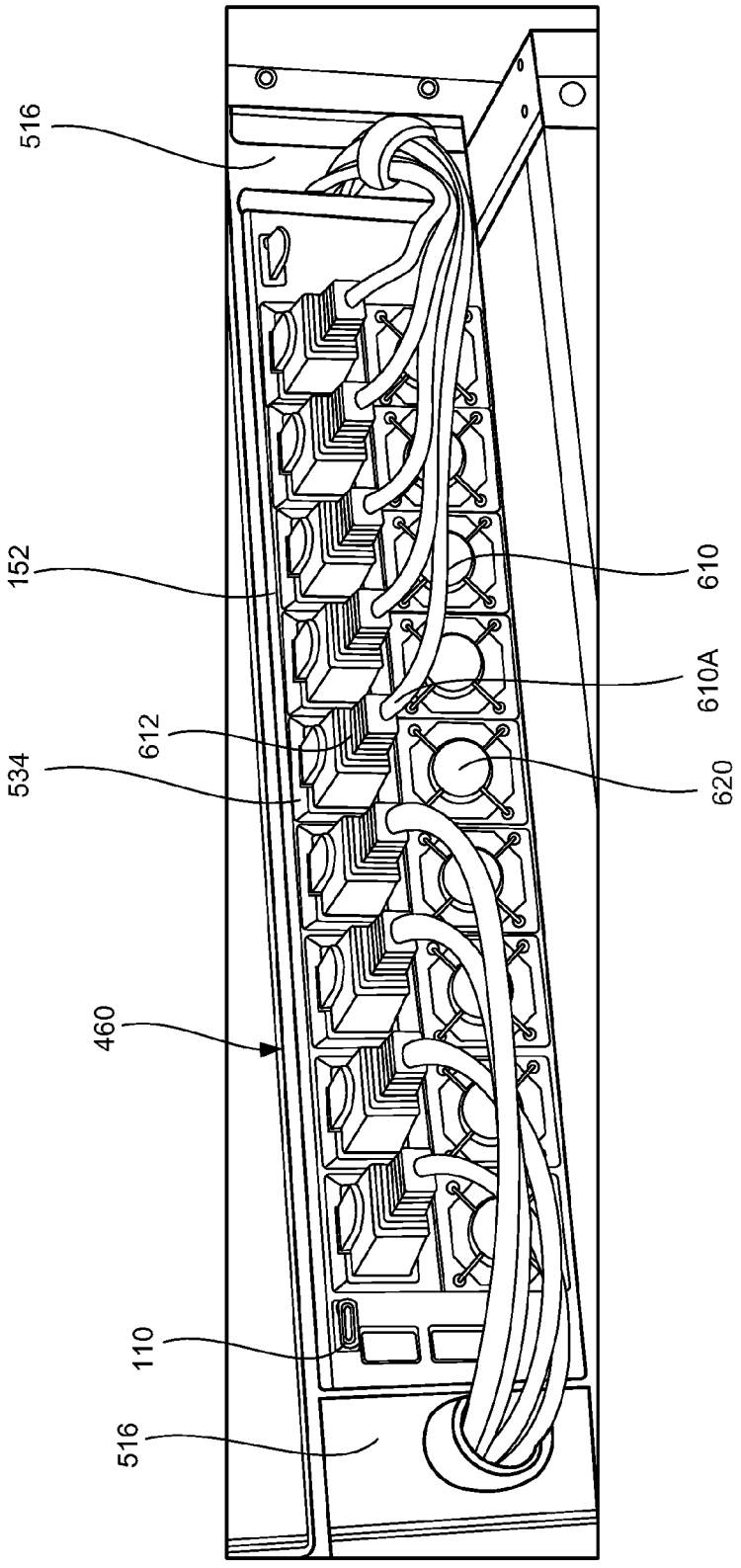


FIG. 6

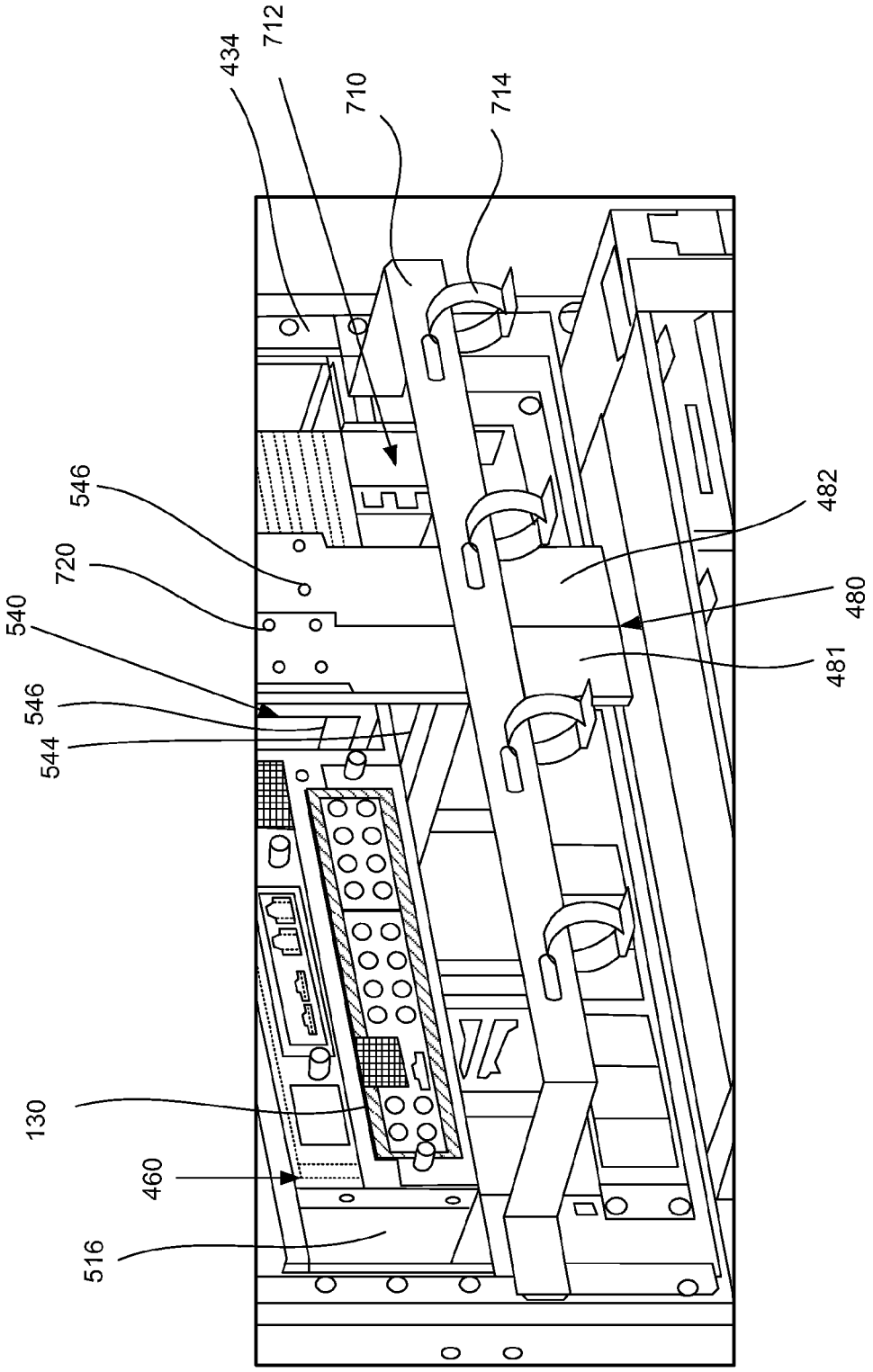


FIG. 7

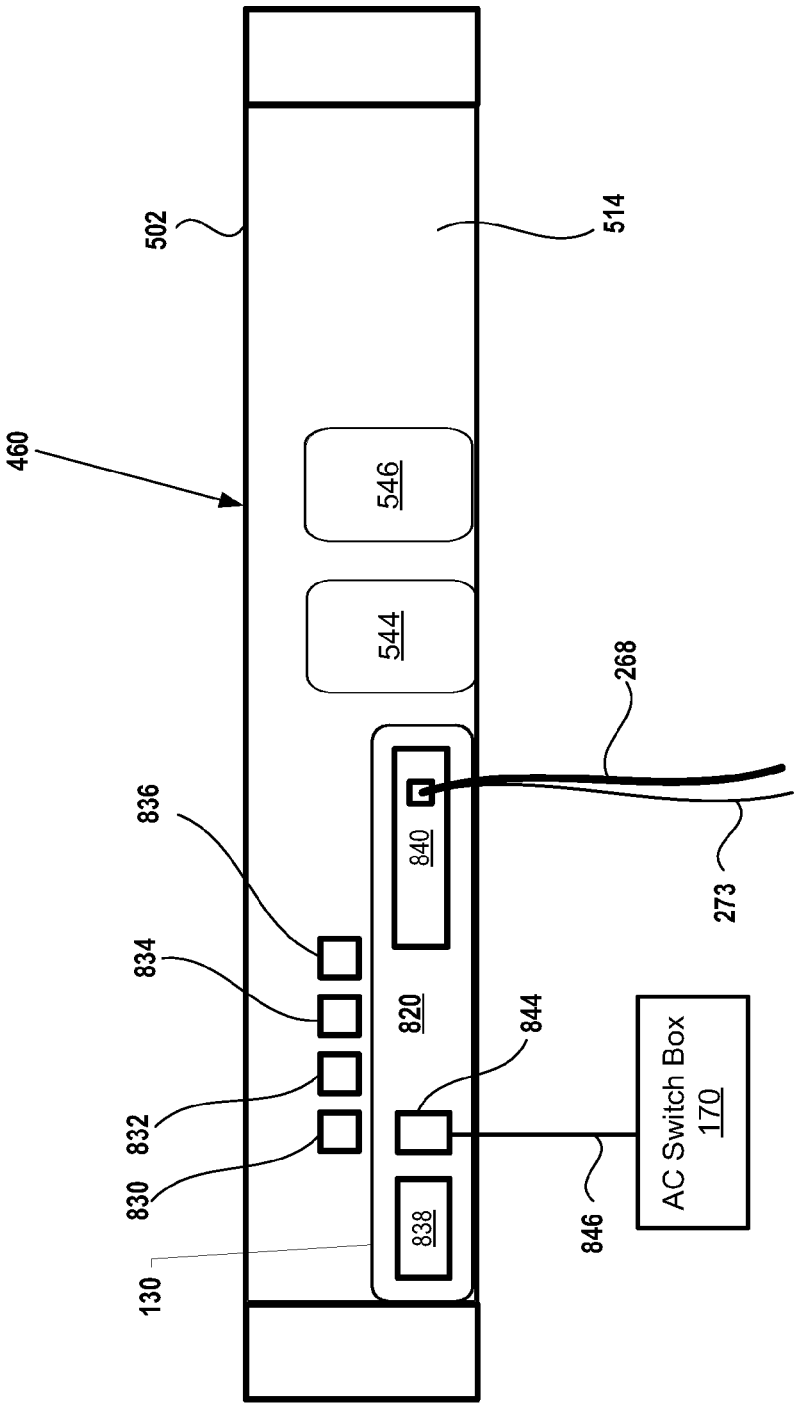

502
514
460
546
544
268
836
840
834
820
844
832
AC Switch Box
170
830
838
846
130
273

FIG. 8A

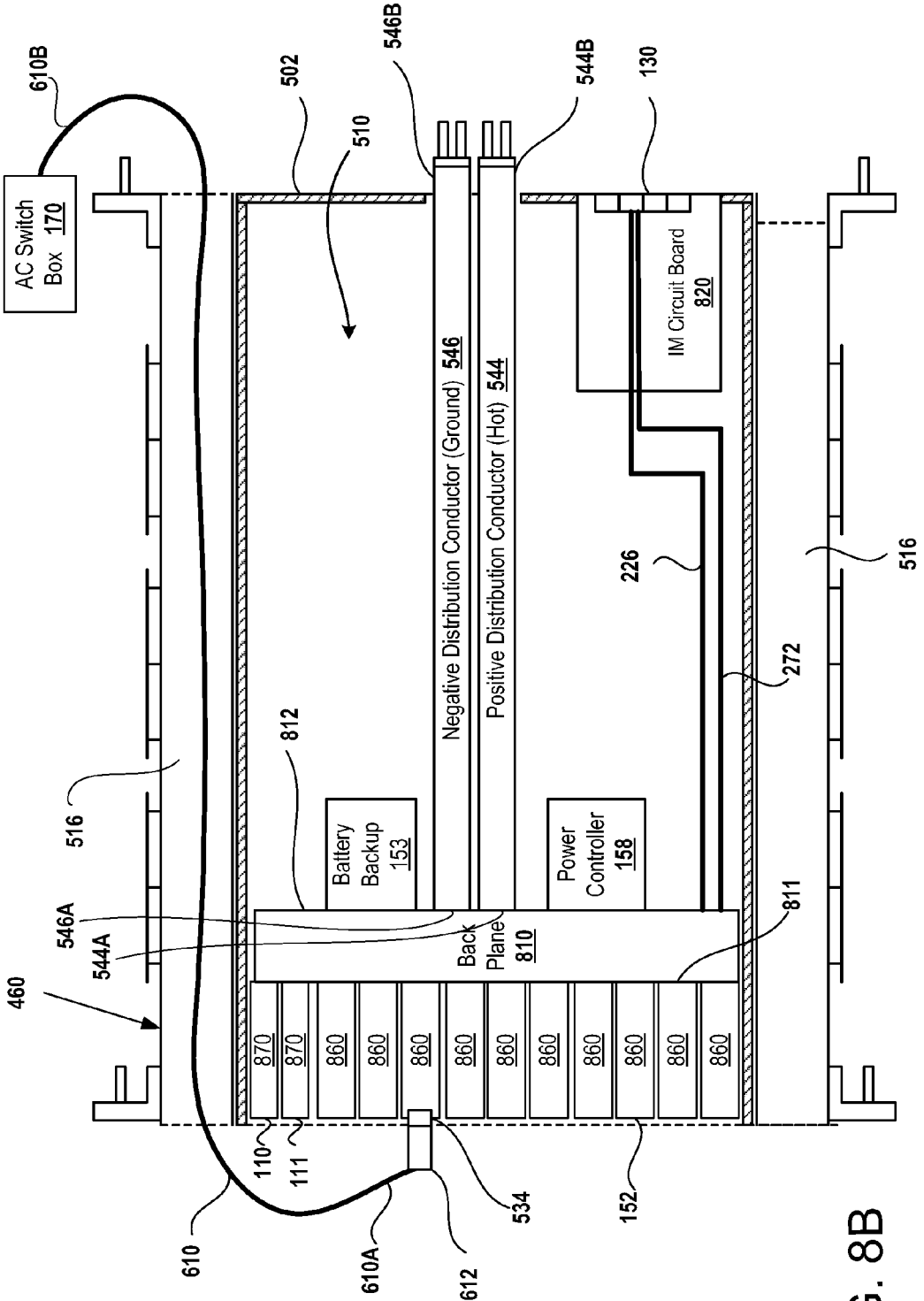
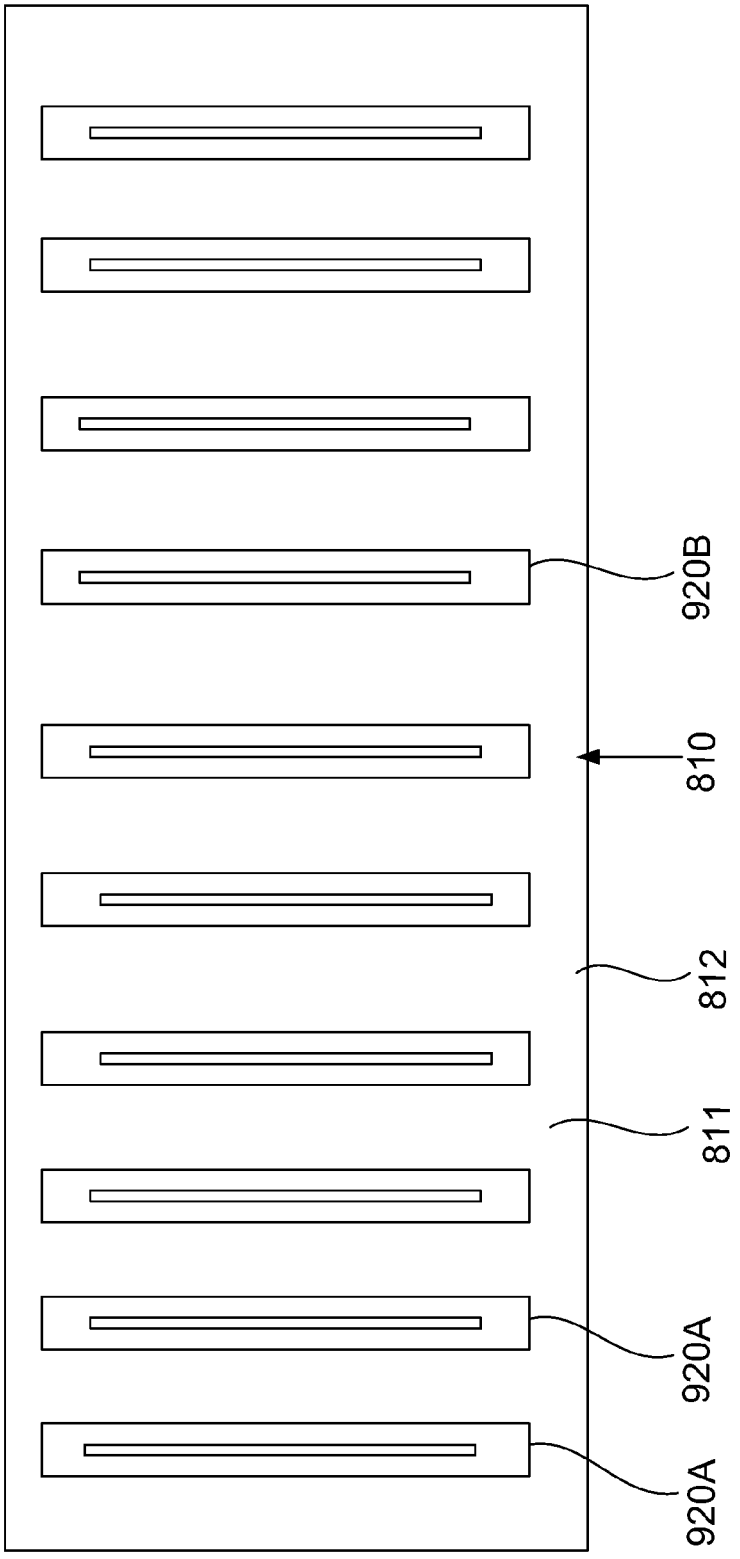

610B
502
546B
544B
130
510
AC Switch Box 170
Negative Distribution Conductor (Ground) 546
Positive Distribution Conductor (Hot) 544
IM Circuit Board 820
226
516
272
812
516
Battery Backup 153
Power Controller 158
546A
544A
Back Plane 810
811
460
870
870
860
860
860
860
860
860
860
860
860
860
110
111
534
152
610
610A
612

FIG. 8B

FIG. 9



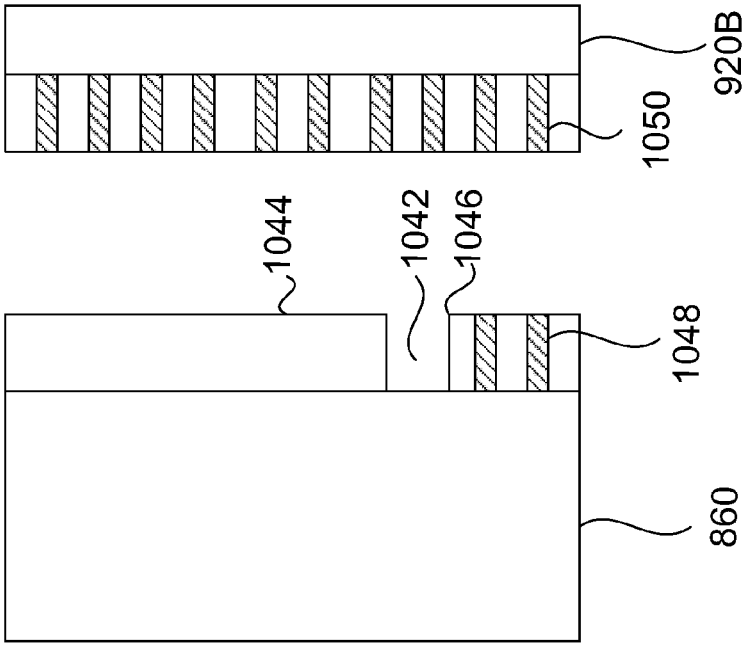


FIG. 10B

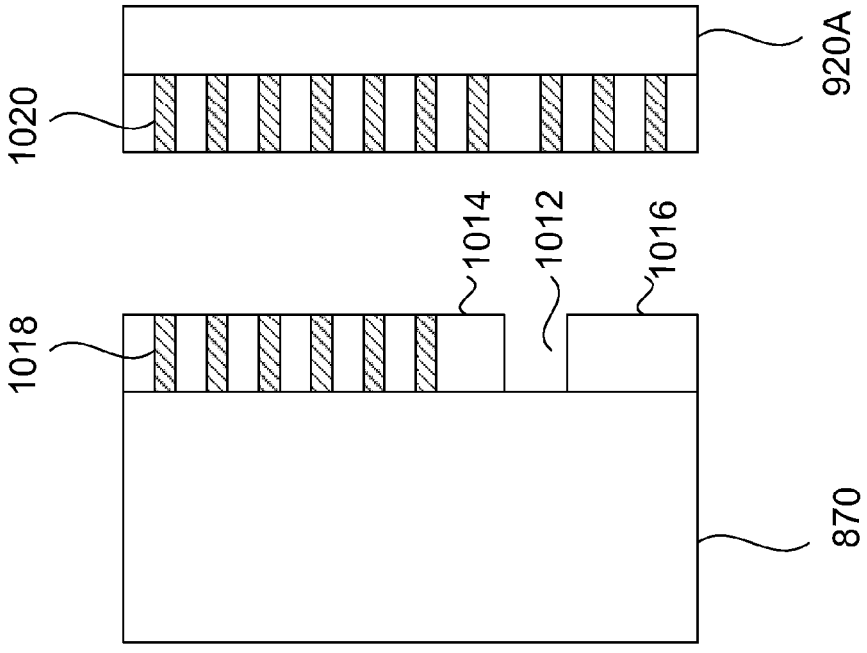


FIG. 10A

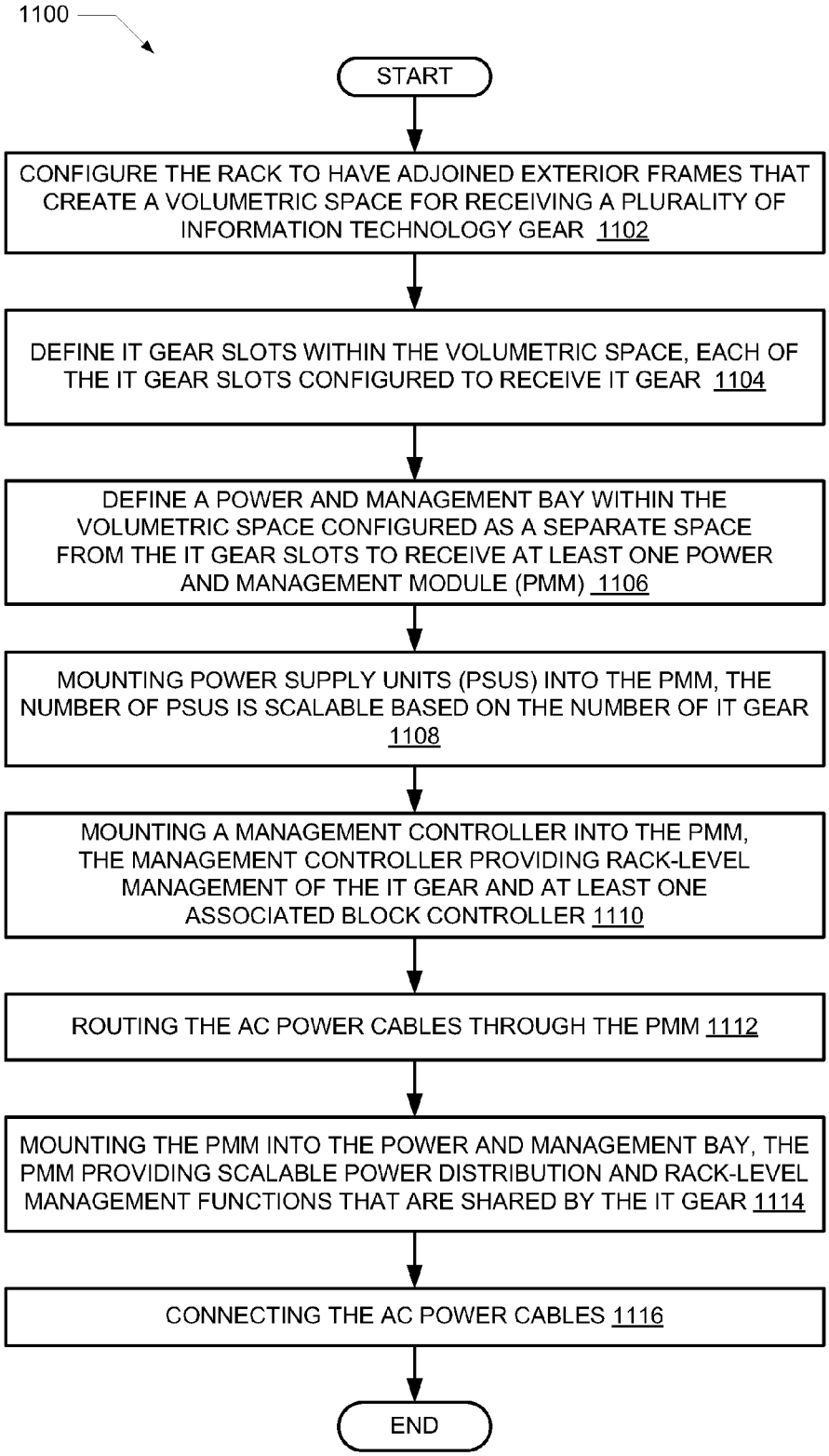

1100
START
CONFIGURE THE RACK TO HAVE ADJOINED EXTERIOR FRAMES THAT CREATE A VOLUMETRIC SPACE FOR RECEIVING A PLURALITY OF INFORMATION TECHNOLOGY GEAR 1102
DEFINE IT GEAR SLOTS WITHIN THE VOLUMETRIC SPACE, EACH OF THE IT GEAR SLOTS CONFIGURED TO RECEIVE IT GEAR 1104
DEFINE A POWER AND MANAGEMENT BAY WITHIN THE VOLUMETRIC SPACE CONFIGURED AS A SEPARATE SPACE FROM THE IT GEAR SLOTS TO RECEIVE AT LEAST ONE POWER AND MANAGEMENT MODULE (PMM) 1106
MOUNTING POWER SUPPLY UNITS (PSUS) INTO THE PMM, THE NUMBER OF PSUS IS SCALABLE BASED ON THE NUMBER OF IT GEAR 1108
MOUNTING A MANAGEMENT CONTROLLER INTO THE PMM, THE MANAGEMENT CONTROLLER PROVIDING RACK-LEVEL MANAGEMENT OF THE IT GEAR AND AT LEAST ONE ASSOCIATED BLOCK CONTROLLER 1110
ROUTING THE AC POWER CABLES THROUGH THE PMM 1112
MOUNTING THE PMM INTO THE POWER AND MANAGEMENT BAY, THE PMM PROVIDING SCALABLE POWER DISTRIBUTION AND RACK-LEVEL MANAGEMENT FUNCTIONS THAT ARE SHARED BY THE IT GEAR 1114
CONNECTING THE AC POWER CABLES 1116
END

FIG. 11

COMBINED POWER AND MANAGEMENT MODULE FOR USE IN A RACK-CONFIGURED INFORMATION HANDLING SYSTEM

BACKGROUND

1. Technical Field

The present disclosure generally relates information handling systems and in particular to a combined power and management module used in a rack-configured information handling system.

2. Description of the Related Art

As the value and use of information continue to increase, individuals and businesses seek additional ways to process and store information. One option available to users is information handling systems. An information handling system generally processes, compiles, stores, and/or communicates information or data for business, personal, or other purposes, thereby allowing users to take advantage of the value of the information. Because technology and information handling needs and requirements vary between different users or applications, information handling systems may also vary regarding what information is handled, how the information is handled, how much information is processed, stored, or communicated, and how quickly and efficiently the information may be processed, stored, or communicated. The variations in information handling systems allow for information handling systems to be general or configured for a specific user or specific use such as financial transaction processing, airline reservations, enterprise data storage, or global communications. In addition, information handling systems may include a variety of hardware and software components that may be configured to process, store, and communicate information and may include one or more computer systems, data storage systems, and networking systems.

Providing power management and cooling to an information handling system is important to prevent loss of data and to maintain system reliability. During operation of an information handling system, events can occur that interrupt or reduce the amount of incoming AC power to the information handling system or the amount of available power from power supplies that deliver electrical power to the information handling system. It is desirable for the information handling system to be able to seamlessly manage both increases and decreases in power demands from the components of the information handling system and to be able to manage interruptions in the delivery of power to the information handling system. Unfortunately, the present power systems for supplying and controlling power in an information handing system take up large amounts of space, require excessive numbers of cables and are difficult to modify if more or less power is required. It is desirable for the power system in an information handling system to be compact and scalable to the power requirements of the information handling system.

BRIEF SUMMARY

Disclosed are a scalable power and management module, an information handling system and a method of constructing a rack-based information handling system having combined power and management within a single module inserted into a rack.

According to one embodiment, a scalable power and management module (PMM) comprises a chassis configured to be slideably inserted into at least one power and management bay within a rack. The PMM provides scalable power distribution and rack-level management functions that are shared by a plurality of IT gear. A plurality of power supply units (PSUs) are mounted in the chassis, where the number of PSUs is scalable based on the number of IT gear. At least one management controller is mounted in the chassis and provides rack-level management of at least one of the IT gear and at least one associated block controller within the rack. A power controller is mounted in the chassis and communicatively coupled to the PSUs and the management controller. The power controller controls power functions of the PMM to control the supply of power to the various IT gear and other components within the rack.

Also disclosed is an information handling system (IHS) that comprises a rack having adjoined exterior frames that create a volumetric space for receiving a plurality of information technology (IT) gear and other functional components. The volumetric space includes a plurality of IT gear slots each configured to receive at least one IT gear. The volumetric space provides at least one power and management bay, which is configured as a separate space from the IT gear slots. At least one power and management module (PMM) is inserted into the at least one power and management bay. The PMM provides scalable power distribution and rack-level management functions that are shared by the plurality of IT gear inserted into the IT gear slots.

According to another embodiment, a method of constructing a rack-based information handling system comprises configuring a rack having adjoined exterior frames that create a volumetric space for receiving a plurality of information technology (IT) gear and other functional components. A plurality of IT gear slots are defined within the volumetric space. Each of the IT gear slots is configured to receive at least one IT gear. At least one power and management bay is defined within the volumetric space and is configured as a separate space from the IT gear slots to receive at least one power and management module (PMM). The at least one power and management module (PMM) is mounted into the at least one power and management bay. The PMM provides scalable power distribution and rack-level management functions that are shared by the plurality of IT gear inserted into the IT gear slots.

The above summary contains simplifications, generalizations and omissions of detail and is not intended as a comprehensive description of the claimed subject matter but, rather, is intended to provide a brief overview of some of the functionality associated therewith. Other systems, methods, functionality, features and advantages of the claimed subject matter will be or will become apparent to one with skill in the art upon examination of the following figures and detailed written description.

BRIEF DESCRIPTION OF THE DRAWINGS

The description of the illustrative embodiments can be read in conjunction with the accompanying figures. It will be appreciated that for simplicity and clarity of illustration, elements illustrated in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements are exaggerated relative to other elements. Embodiments incorporating teachings of the present disclosure are shown and described with respect to the figures presented herein, in which:

FIG. **1** is a block diagram illustration of an example modular, scalable and expandable (MSE) rack-based information handling system, according to one or more embodiments;

FIG. **2** is a front perspective view illustrating a modular rack having inserted PMMs and IT gear, in accordance with one embodiment;

FIG. **3** is a rear perspective view of the modular rack having inserted PMMs and a power bay busbar, in accordance with one embodiment;

FIG. **4** is a front perspective view illustrating a modular rack having inserted PMMs and switch modules, in accordance with one embodiment;

FIG. **5**A is a rear perspective view of two stacked PMMs, in accordance with one embodiment;

FIG. **5**B is a front perspective view of two stacked PMMs, in accordance with one embodiment;

FIG. **5**C is a front perspective view of an individual PMM, in accordance with one embodiment;

FIG. **5**D is a rear perspective view of an individual PMM, in accordance with one embodiment;

FIG. **6** is a front view of a PMM with attached AC power cables, in accordance with one embodiment;

FIG. **7** is an enlarged rear perspective view of the modular rack illustrating details of the cable bar tie-bar and busbar segments, in accordance with one embodiment;

FIG. **8**A is a rear view of a PMM, in accordance with one embodiment;

FIG. **8**B is a top cross-sectional view of a PMM, in accordance with one embodiment;

FIG. **9** is a front view of a backplane with connector receptacles;

FIG. **10**A is a side view of a management controller circuit board and backplane connector receptacles in accordance with one embodiment;

FIG. **10**B is a side view of a power supply circuit board and backplane connector receptacles in accordance with one embodiment; and

FIG. **11** is a flow chart illustrating one example of a method for constructing a rack-based information handling system with a combined PMM, according to one or more embodiments.

DETAILED DESCRIPTION

The illustrative embodiments provide a scalable power and management module (PMM), an information handling system (IHS) and a method of constructing a rack-based information handling system with a PMM. The PMM provides scalable power distribution and rack-level management functions that are shared by several IT gear within a rack IHS.

In the following detailed description of exemplary embodiments of the disclosure, specific exemplary embodiments in which the disclosure may be practiced are described in sufficient detail to enable those skilled in the art to practice the disclosed embodiments. For example, specific details such as specific method orders, structures, elements, and connections have been presented herein. However, it is to be understood that the specific details presented need not be utilized to practice embodiments of the present disclosure. It is also to be understood that other embodiments may be utilized and that logical, architectural, programmatic, mechanical, electrical and other changes may be made without departing from general scope of the disclosure. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present disclosure is defined by the appended claims and equivalents thereof.

References within the specification to "one embodiment," "an embodiment," "embodiments", or "one or more embodiments" are intended to indicate that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. The appearance of such phrases in various places within the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Further, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not other embodiments.

It is understood that the use of specific component, device and/or parameter names and/or corresponding acronyms thereof, such as those of the executing utility, logic, and/or firmware described herein, are for example only and not meant to imply any limitations on the described embodiments. The embodiments may thus be described with different nomenclature and/or terminology utilized to describe the components, devices, parameters, methods and/or functions herein, without limitation. References to any specific protocol or proprietary name in describing one or more elements, features or concepts of the embodiments are provided solely as examples of one implementation, and such references do not limit the extension of the claimed embodiments to embodiments in which different element, feature, protocol, or concept names are utilized. Thus, each term utilized herein is to be given its broadest interpretation given the context in which that terms is utilized.

Further, those of ordinary skill in the art will appreciate that the hardware components and basic configuration depicted in the various figures (e.g. FIG. **1**) and described herein may vary. For example, the illustrative components within IHS **100** (FIG. **1**) are not intended to be exhaustive, but rather are representative to highlight components that can be utilized to implement various aspects of the present disclosure. For example, other devices/components/modules may be used in addition to or in place of the hardware and software modules depicted. The depicted examples do not convey or imply any architectural or other limitations with respect to the presently described embodiments and/or the general disclosure.

FIG. **1** illustrates a block diagram representation of an example information handling system (IHS) **100**, within which one or more of the described features of the various embodiments of the disclosure can be implemented. For purposes of this disclosure, an information handling system, such as IHS **100**, may include any instrumentality or aggregate of instrumentalities operable to compute, classify, process, transmit, receive, retrieve, originate, switch, store, display, manifest, detect, record, reproduce, handle, or utilize any form of information, intelligence, or data for business, scientific, control, or other purposes. For example, an information handling system may be a handheld device, personal computer, a server, a network storage device, or any other suitable device and may vary in size, shape, performance, functionality, and price. The information handling system may include random access memory (RAM), one or more processing resources such as a central processing unit (CPU) or hardware or software control logic, ROM, and/or other types of nonvolatile memory. Additional components of the information handling system may include one or more disk drives, one or more network ports for com-

municating with external devices as well as various input and output (I/O) devices, such as a keyboard, a mouse, and a video display. The information handling system may also include one or more buses operable to transmit communications between the various hardware components.

Referring specifically to FIG. **1**, there is illustrated a two-dimensional block diagram of an example rack-based IHS **100** configured within a modular, expandable rack with modular configuration of various functional components inserted therein. As a two-dimensional image, certain of the presented components are shown in different orientations relative to each other for simplicity in describing the connectively of the components. For example, while certain components are shown separate from the power subsystem, in actual implementation, these components can be located on or within a power bay housing several of the components of the power subsystem. Similarly, while the power subsystem is shown with specific components within a single block, these components are not necessarily contained in a unitary structure. For example, the bus bar can be modularly extended along the entire vertical run of the rack with only one sub-section in direct connection with or located within or proximate to the actual power bay. For purposes of the disclosure, all general references to an information handling system shall refer to the MSE rack-based IHS **100**, while references to actual processing nodes within the IHS **100** are understood to refer to chassis-level processing nodes or other IT gear that can be located on physical sleds within the various blocks defined within the rack. It is further appreciated that within the MSE rack-based IHS **100** can be multiple, separate domains or computing systems that operate independent of each other and can be assigned to different independent customers and/or users. Even when configured as separate computing systems, however, the rack-based IHS provides rack-level power management and control of these systems as a unitary IHS. The level of detail of the actual use of the processing nodes within the general rack-level IHS **100** is not relevant to the descriptions provided herein and are specifically omitted.

As presented in FIG. **1**, IHS **100** comprises rack casing **105**, which can comprise one or more panels of sheet metal or other material interconnected to form a three dimensional volume generally referred to in the industry as a rack. The various components are communicatively connected to one or more other components via power and communication cables, which are generally represented by the connecting lines of FIG. **1**. IHS **100** comprises a hierarchical arrangement of multiple management modules, along with power and cooling components, and functional processing components or IT gear located within end nodes. At the rack level, IHS **100** includes management controller (MC) **110** communicatively connected to infrastructure manager (IM) **130**. MC **110** includes a microcontroller **112** (also generally referred to as a processor) which is coupled via an internal bus to memory **114**, I/O interface controller **116**, removable storage device (RSD) interface **118** and storage **120**. Memory **114** can be flash or other form of memory. Illustrated within memory **114** is rack-level power management and control (RPMC or PMC) firmware **115**, which is inclusive of the firmware that controls the operation of MC **110** in communicating with and managing the down-stream components (i.e., blocks and processing nodes, etc.) of IHS **100**. I/O interface **116** provides connection points and hardware and firmware components that allow for user interfacing with the MC **110** via one or more connected I/O devices, such as a keyboard, a mouse, and a monitor. I/O interface **116** enables a user to enter commands via, for example, a command line interface (CLI), and to view status information of IHS **100**. I/O interface **116** also enables the setting of operating parameters for IHS **100**, among other supported user inputs.

RSD interface **118** enables insertion or connection of a RSD **119**, such as an SD card containing pre-programmable operating firmware for IHS **100**. In at least one embodiment, a RSD **119** stores a copy of the operating parameters of IHS **100** and the RSD **119** can be utilized to reboot the IHS **100** to its operating state following a system failure or maintenance shutdown. Storage **120** can be any form of persistent storage and can include different types of data and operating parameters (settings) **122** utilized for functional operation of IHS **100**. Among the stored content within storage **120** can also be algorithms **124** for fan and/or power and/or control. In one or more embodiments, IHS **100** can optionally include at least one other MC, illustrated as second MC **111**, to provide a redundant configuration of MCs **110**,**111**, which, in one embodiment, are both simultaneously active and functioning. With this embodiment, the redundant configuration and parallel operation of MCs **110**/**111** enables IHS **100** to continue operating following a failure of either of the MCs **110**/**111** or in the event one of the MCs **110**/**111** has to be taken offline for maintenance.

Infrastructure manager **130** includes cooling subsystem interface **132**, Ethernet switch **134**, power distribution interface **136** and network interface **138**. Network interface **138** enables IHS **100** and specifically the components within IHS **100** to connect to and communicate with or via an external network **180**.

In addition to the above-described MC **110** and IM **130**, IHS **100** further comprises cooling subsystem **140**, power subsystem **150**, and a plurality of blocks **160**, individually labeled as blocks A-D **160**A-**160**D. In one implementation, each block **160** has an associated block controller (BC) **162**. Cooling subsystem **140** includes a plurality of fan modules of which a first fan module **142** and a second fan module **145** are shown. These fan modules **142**, **145** are located within a respective fan bay (not shown) and can be different sizes and provide different numbers of fans per module. Also included within cooling subsystem **140** is a plurality of temperature sensors **144**, which are further shown distributed within or associated with specific blocks **160**. Cooling subsystem of IHS **100** further includes some design features of rack casing **105**, such as perforations for air flow and other design features not expanded upon within the present description. Each fan module **142**-**145** is located behind (or in the air flow path of) a specific block **160** and the fan module **142**-**145** is communicatively coupled to and controlled by the block controller **162** associated with that block **160**. Within each block **160** is at least one, and likely a plurality of processing nodes **164**. As one aspect of the disclosure, the number of nodes that can be placed within each block and/or supported by a single block controller can vary up to a maximum number (e.g., 16) based on the block dimension relative to the size and configuration of each processing node. Additionally, as provided by block D **160**D, one or more of the blocks can be utilized to provide rack-storage of storage devices. Also, as shown with blocks B **160**B and C **160**C, a single block controller **162**B can be assigned to control multiple blocks, when the number of processing nodes within an individual block does not exceed the pre-established BC threshold. In at least one implementation, the BC threshold can be set to 16 nodes. Each node controlled by a respective BC **162** is communicatively coupled to the BC **162** via one or more cables (not shown).

Switch **134** enables MC **110** to communicate with block controllers **162** via a network of Ethernet cables **180**. Specifically, according to at least one embodiment, MC **110** provides certain control and/or management signals to BCs **162** via one or more select wires within the Ethernet cables **180**, which select wires are one or more of the additional wires within the Ethernet cable that are not utilized for general system and network communication.

Power subsystem **150** generally includes a plurality of power supply units (PSUs) **152**, one or more power distribution units **154** (PDUs), and a modular busbar **156**. Power subsystem **150** also includes a source of external power, AC power **190** that supplies AC power to AC switch **170**. Each of the individual nodes and other components within IHS **100** that require power are either directly coupled to modular busbar **156** or coupled via power cables to PDUs **154** to obtain power. As one aspect of power distribution within IHS **100**, MC **110** can monitor power consumption across the IHS **100** as well as the amount of available power provided by the functional PSUs **152** and MC **110** can trigger changes in power consumption at the block level and ultimately at the (processing) node level based on changes in the amount of available power and other factors. Control of the power subsystem **150** can, in one embodiment, be provided by a separate power controller **158**, separate from MC **110**. As further illustrated, one additional aspect of the power system for the MSE rack-based IHS **100** provide for the inclusion of AC Switch **170**. AC switch **170** is communicatively coupled to both IM **130** and power subsystem **150**. AC Switch **170** includes a plurality of AC inputs **172** and a plurality of AC outlets **174** that are utilized to supply power to the PSUs **152**, and other functional components of MSE rack-based IHS **100** that require AC power.

Other features and functionality of IHS **100** will be described in greater detail hereafter with reference to one or more of the following figures.

FIGS. **2**, **3** and **4** illustrate details of a modular rack-based IHS **100** having slots and bays containing inserted power and management modules (PMMs) and processing nodes. The figures are described together, with reference numerals for certain components provided as needed on specific ones of the figures, but not necessarily on all of the figures. Referring to FIGS. **2-4**, rack-based IHS **100** comprises a rack **105** having adjoined exterior frames **402** that enclose and define a volumetric space **404** for receiving one or more pieces of information technology (IT) gear **406**. IT gear **406** can include various computer processing and storage devices such as block controllers **162** and processing nodes **164**. Rack **105** has a front side **407**, a back or rear side **408**, a right side **409** and a left side **411**. Rack **105** further has a top side **413** and a bottom side **415**. Rack **105** is divided into several zones or sections. Rack **105** has a top IT gear section **410**, an upper IT gear section **412**, a lower IT gear section **414**, two central switch sections **416**, **418** and a central power and management section **420**.

Adjoined exterior frames **402** include an upper frame **422** that defines upper IT gear section **412**, a lower frame **424** that defines lower IT gear section **414**, and central frame **426** that defines central switch sections **416**, **418** and central power and management section **420**. Upper frame **422** is connected to central frame **426** which is connected to lower frame **424**.

Frames **402** include a top panel **430**, a bottom panel **432**, support posts **434** and cross-members **436**. Four support posts **434** are arranged vertically with cross members **436** extending between the front and back support posts along opposite sides of frame **402**. Top panel **430**, is affixed to the top of support posts **434** and bottom panel **432** is affixed to the bottom of support posts **434**. Mounting rails **438** are mounted to cross members **436** and are oriented parallel to support posts **434**. Mounting rails **438** extend between top panel **430** and bottom panel **432**. Upper IT gear section **412** and lower IT gear section **414** have several IT gear slots **440** that are configured to receive at least one of the IT gear **406**. IT gear slots **440** are formed by ribs **442** mounted to opposed interior portions of mounting rails **438**. The various components of rack **105** can be attached to each other using suitable methods such as welding or by the use of fasteners.

Central frame **426** has power and management bays **444** that are configured as a separate space from the IT gear slots **440**. Although FIG. **3** shows two power and management bays **444**, rack **105** can have more or fewer power and management bays **444**. Slide rails **446** are mounted in power and management bays **444** to support posts **434**. Slide rails **446** are perpendicular to support posts **434** and extend across mounting rails **438**. Slide rails **446** can move into and out of power and management bays **444**. Central frame **426** also has switch bays **448** that are separate from power and management bays **444**. One switch bay **448** is located above the upper power and management bay **444** and the other switch bay **448** is located below the lower power and management bay **444**. A pair of spaced-apart, opposed, U-shaped channels **450** are mounted perpendicular to cross members **436** in each of the switch bays **448**.

A power and management module (PMM) **460** is inserted into and received by each of power and management bays **444**. PMM **460** provides scalable power distribution and rack-level management functions that are shared by the IT gear **406** inserted into the IT gear slots **440**. Specifically PMM **460** is mounted to slide rails **446** such that PMM **460** can be moved between an inserted or retracted position into power and management bay **444** and an extended position out from power and management bay **444**. PMM **460** contains management controllers **110** and PSUs **152** (FIG. **1**).

A switch module **470** is inserted into and received by each of switch bays **448**. Switch module **470** provides switch communication functions to IHS **100**. Specifically switch module **470** is mounted to U-shaped channels **450**. A power bay busbar **480** is mounted to the rear side **408** of rack **105**. Power bay busbar **480** is a modular assembly that includes several interconnected busbar segments that together extend along the entire length of the rear side **408** of the rack **105**, between top side **413** and bottom side **415**. Power bay busbar **480** has an upper end **480**A and a lower end **480**B. Power bay busbar **480** provides power and ground to the IT gear **406** mounted in rack **105**. Power bay busbar **480** includes two separate busbars, a power busbar **481** and a ground busbar **482**.

Rack **105** further includes fan module holders (or fan bays) **490** mounted to the back side **408** of rack **105**. Fan module holders **490** (also referred to as fan bays) are attached to support posts **434** and extend across the back section of IT gear slots **440**. Fan module holders **490** are configured to receive a fan module. PMM **460** is accessible from the back side **408** of rack **105**, such that the IT gear **406** can be inserted into and made accessible from the front side **407** of the rack **105**, independent of and without interfering with access to PMM **460** from the back side **408** of the rack.

FIGS. **5**A-D illustrate details of power and management module (PMM) **460**. The figures are described within one unitary description, with reference numerals of some components provided in certain figures but not in others. Referring to FIGS. **5**A-D, PMM **460** comprises a housing or

chassis **502** formed by a top wall **504**, bottom wall **506** and side walls **508** that enclose a cavity **510**. The chassis **502** is adapted to be received by the slide rails **446** such that PMM **460** is moveable between a first extended position outside of the power and management bay **444** and a second retracted position within the power and management bay **444**. PMM **460** has a front side **512** (FIG. **5**B) and a back side **514** (FIG. **5**A). Cable routing channels **516** extend through cavity **510** on opposing, exterior sides of chassis **502**. Cable routing channels **516** are used to receive and route electrical cables within PMM **460**. Several circuit board guide rails **520** (FIG. **5**C) are mounted to the inner surface of bottom wall **506** and extend from front side **512** partially towards back side **514**. Several dividing walls **522** extend between top wall **504** and bottom wall **506**. Dividing walls **522** define a series of power supply slots **524** and management controller slots **526** within chassis **502**. Power supply units (PSUs) **152** are mounted in power supply slots **524** and retained by circuit board guide rails **520**. The number of PSUs **152** mounted in PMM **460** is scalable based on the number of IT gear **406** in rack **105**.

Management controllers (MCs) **110** are mounted in management controller slots **526** and retained by circuit board guide rails **520**. A cover **530** is mounted to top wall **504** and bottom wall **506** and extends over PSUs **152**. Each cover **530** has a receptacle opening **532**. Each PSU **152** has an AC power receptacle **534** that extends through receptacle opening **532**. With specific reference to FIG. **5**D, an infrastructure manager **130** is mounted in each PMM **460**. Infrastructure manager **130** is mounted in cavity **510** towards back side **514**. Busbar segment **540** is mounted in cavity **510** towards back side **514**. Busbar segment **540** provides a power and ground connection for DC power between PSUs **152** and power bay busbar **480**. Busbar segment **540** includes two separate busbar segments, a power or hot busbar segment **542** and a ground busbar segment **544**. Bolts **546** extend through both busbar segments **542** and **544** and are used to provide a mechanical and electrical connection to respective power busbar **481** and ground busbar **482**. A shield or faraday cage **548** is mounted to the back side of chassis **502** around busbar segment **540**. Shield **548** prevents accidental shorts by stopping external objects from coming into contact with power bay busbar **480** and/or busbar segment **540**.

FIG. **6** illustrates details of PMM **460** with attached AC power cables **610**. AC power cables **610** have ends **610**A and **610**B (see FIG. **8**B). End **610**A has attached plug **612**. Plug **612** is plugged into power supply receptacle **534**. AC power cables **610** are routed through cable channel **516** and extend from the front side **512** to the back side **514** of chassis **502** where cable ends **610**B are connected to AC switch box **170** (FIG. **1**). The AC power cables **610** supply AC power from the AC switch box **170** to the connected PSUs **152**. Each PSU **152** has a fan **620** that is mounted to PSU **152**. Fan **620** cools the components of PSU **152** when PSU **152** is in operation.

With reference to FIG. **7**, additional details of PMM **460** are shown. Busbar segment **540** is connected to power bay busbar **480**. Busbar segment **540** provides a power and ground connection for DC power between PSUs **152** and power bay busbar **480**. Busbar segment **540** includes two separate busbar segments, a power busbar segment **542** and a ground busbar segment **544**. Threaded bolts **546** extend through busbar segments **542** and **544** and are received by threaded apertures **720** in power busbar **481** and ground busbar **482**.

A cable tie-bar **710** has ends attached by fasteners to support members **434** of rack **105**. Cable tie-bar **710** is used to provide an attachment point for cables such as AC power cables **610** (FIG. **6**) run within rack **105**. Cable tie-bar **710** defines a cable channel through which cables can be routed. A cable tie **714** can further be mounted to tie-bar **710** to retain cables to tie-bar **710**.

With reference now to FIGS. **8**A and **8**B, further details of PMM **460** are shown. Infrastructure manager (IM) **130** is mounted in chassis **502**. IM **130** includes an IM printed circuit board **820** that contains electronic components that implement the functions performed by IM **130**. The IM circuit board **820** is mounted in chassis **502** and connected to MC **110** and/or MC **111** by Ethernet cable **226** via backplane **810**. IM circuit board **820** has several attached connectors including a battery connector **830**, an MC connector **832**, an Ethernet MC1 connector **834**, an Ethernet MC2 connector **836**, a serial connector **838** and an Ethernet connector **840**. Battery connector **830** is connected by a cable to backup battery **153**. MC connector **832** is connected by a cable to MC **110**. Ethernet MC1 connector **834** is connected by an Ethernet cable **226** to MC **110**. Ethernet MC2 connector **836** is connected by another Ethernet cable to MC **111**. Serial connector **838** is connected to a serial bus by a cable. Connector **844** is connected to AC switch box **170** by a cable **846**.

Ethernet connectors **834**, **836** and **840** are positioned to face toward a back side **514** of chassis **502**. Ethernet connector **840** is connected to Ethernet cable **268** having an allocated global throttle wire **273** directly connecting a plurality of block controllers **162** (FIG. **1**) within the rack **105** with the management controller **110**. The global throttle wire **273** provides communication of a global throttle power reduction (GTPR) signal from the IM **130** to the specific associated block controller **162**. The block controllers **162** within IHS **100** are pre-programmed to respond to an assertion of a signal on the global throttle wire **273** by the management controller **110** by immediately throttling operations of one or more of the IT gear **406**.

Backplane **810** is mounted in chassis **502**. Backplane **810** is a printed circuit board with multiple ground, power and signal layers. Backplane **810** has a front side **811** and a back side **812**. Each of PSUs **152** include a power supply circuit board **860** that is received by and connected to a connector receptacle mounted to front side **811**. Each MC **110**, **111** includes a management controller circuit board **870** that is received by and connected to a connector receptacle mounted to backplane front side **811**. Backup battery **153** and power controller **158** are connected to the backplane back side **812**. Power busbar segment **544** and ground busbar segment **546** have respective proximal ends **544**A and **546**A that are connected to the backplane back side **812**. The distal ends **544**B and **546**B of the busbar segments are connected to respective power bay busbars **481** and **482**. AC power cables **610** have ends **610**A and **610**B. End **610**A has attached plug **612**. Plug **612** is plugged into power supply receptacle **534** that is connected to power supply circuit board **860**. AC power cables **610** are routed through cable channel **516** and extend from the front side **512** to the back side **514** of chassis **502** where cable ends **610**B are connected to AC switch box **170**. The AC power cables **610** supply AC power from the AC switch box **170** to the connected PSUs **152**.

FIG. **9** illustrates details of backplane **810**. Backplane **810** has a front side **811** and a back side **812**. Several connector receptacles **920** are mounted to front side **811**. Connector receptacles **920** include management controller circuit board receptacles **920**A and power supply circuit board receptacles **920**B. Management controller circuit board receptacles **920**A are adapted to receive management controller circuit

boards **870**. Power supply circuit board receptacles **920**B are adapted to receive power supply circuit boards **860**.

FIGS. **10**A-B illustrate details of management controller circuit board **870** and power supply circuit board **860**. Management controller circuit board **870** includes an orientation slot **1012**, a narrow end **1016** and a wide end **1014**. Wide end **1014** has several terminals **1018** formed thereon. Terminals **1018** are connected to printed circuit lines (not shown). Management controller circuit board receptacle **920**A has sockets **1020**. When management controller circuit board **870** is inserted into management controller circuit board receptacle **920**A, terminals **1018** mate with sockets **1020** to form an electrical connection.

Power supply circuit board **860** includes an orientation slot **1042**, a narrow end **1046** and a wide end **1044**. Wide end **1044** has several terminals **1048** formed thereon. Terminals **1048** are connected to printed circuit lines (not shown). Power supply circuit board receptacle **920**B has sockets **1050**. When power supply circuit board **860** is inserted into power supply circuit board receptacle **920**B, terminals **1048** mate with sockets **1050** to form an electrical connection. According to one aspect of the disclosure, management controller circuit boards **870** can be oriented and inserted into circuit board receptacle **920**A in a first orientation, while power supply circuit boards **860** can be inverted 180 degrees from management controller circuit boards **870** and inserted into circuit board receptacle **920**B.

FIG. **11** illustrates a flowchart of an exemplary method for constructing a rack-based information handling system. The description of method **1100** is provided with general reference to the specific components illustrated within the preceding FIGS. **1-10**. With specific reference to FIG. **11**, method **1100** begins at the start block and proceeds to block **1102** where rack **105** is configured to have adjoined exterior frames **402** that create a volumetric space **404** for receiving a plurality of information technology (IT) gear **406** and other functional components. A plurality of IT gear slots **440** are defined within the volumetric space **404** (block **1104**). Each of the IT gear slots **440** are configured to receive at least one IT gear **406**. A power and management bay **444** is defined within the volumetric space **404** (block **1106**) and is configured as a separate space from the IT gear slots **440** to receive at least one power and management module (PMM) **460**. A plurality of power supply units (PSUs) **152** are mounted into the PMM **460** (block **1108**). The number of PSUs is scalable based on the number of IT gear **406**. A management controller **110**, **111** is mounted into the PMM **460** (block **1110**). The management controller **110**, **111** provides rack-level management of the IT gear **406** and at least one associated block controller **162** within the IHS **100**. AC power cables **610** are routed through PMM **460** (block **1112**). PMM **460** is mounted into the power and management bay **444** (block **1114**). PMM **460** provides scalable power distribution and rack-level management functions that are shared by the plurality of IT gear **406** inserted into the IT gear slots **440**. The AC power cables **610** are connected to the PSUs **152** and the AC switch box **170** (block **1116**). Method **1100** then ends.

In the above described flow chart, certain steps of the methods can be combined, performed simultaneously or in a different order, or perhaps omitted, without deviating from the scope of the disclosure. Thus, while the method blocks are described and illustrated in a particular sequence, use of a specific sequence of functional processes represented by the blocks is not meant to imply any limitations on the disclosure. Changes may be made with regards to the sequence of processes without departing from the scope of the present disclosure. Use of a particular sequence is therefore, not to be taken in a limiting sense, and the scope of the present disclosure is defined only by the appended claims.

Aspects of the present disclosure are described above with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems) and computer program products according to embodiments of the disclosure. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer program instructions in a rack design software, for example. Computer program code for carrying out operations for aspects of the present disclosure may be written in any combination of one or more programming languages, including an object oriented programming language, without limitation. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, such as a service processor, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, performs the method for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

One or more of the embodiments of the disclosure described can be implementable, at least in part, using a software-controlled programmable processing device, such as a microprocessor, digital signal processor or other processing device, data processing apparatus or system. Thus, it is appreciated that a computer program for configuring a programmable device, apparatus or system to implement the foregoing described methods is envisaged as an aspect of the present disclosure. The computer program may be embodied as source code or undergo compilation for implementation on a processing device, apparatus, or system. Suitably, the computer program is stored on a carrier device in machine or device readable form, for example in solid-state memory, magnetic memory such as disk or tape, optically or magneto-optically readable memory such as compact disk or digital versatile disk, flash memory, etc. The processing device, apparatus or system utilizes the program or a part thereof to configure the processing device, apparatus, or system for operation.

As will be further appreciated, the processes in embodiments of the present disclosure may be implemented using any combination of software, firmware or hardware. Accordingly, aspects of the present disclosure may take the form of an entirely hardware embodiment or an embodiment combining software (including firmware, resident software, micro-code, etc.) and hardware aspects that may all generally be referred to herein as a "circuit," "module," or "system." Furthermore, aspects of the present disclosure may take the form of a computer program product embodied in one or more computer readable storage device(s) having computer readable program code embodied thereon. Any combination of one or more computer readable storage device(s) may be utilized. The computer readable storage device may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples (a non-exhaustive list) of the computer readable storage device would include the following: an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or

Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. In the context of this document, a computer readable storage device may be any tangible medium that can contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device.

While the disclosure has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the disclosure. In addition, many modifications may be made to adapt a particular system, device or component thereof to the teachings of the disclosure without departing from the essential scope thereof. Therefore, it is intended that the disclosure not be limited to the particular embodiments disclosed for carrying out this disclosure, but that the disclosure will include all embodiments falling within the scope of the appended claims. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the disclosure. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

The description of the present disclosure has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the disclosure in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope of the disclosure. The described embodiments were chosen and described in order to best explain the principles of the disclosure and the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A scalable power and management module (PMM) comprising:

a chassis configured to be slideably inserted into at least one power and management bay within a rack, the PMM providing scalable power distribution and rack-level management functions that are shared by a plurality of IT gear;

a plurality of power supply units (PSUs) mounted in the chassis, wherein the number of PSUs is scalable based on the number of IT gear;

at least one management controller mounted in the chassis that provides rack-level management of at least one of the IT gear and at least one associated block controller within the rack;

a power controller mounted in the chassis and communicatively coupled to the PSUs and the at least one management controller, the power controller controlling power functions of the PMM;

an infrastructure manager circuit board mounted in the chassis and connected to the management controller by a first Ethernet cable; and

at least one Ethernet connector mounted to the infrastructure manager circuit board, the Ethernet connector facing toward a back side of the chassis, the Ethernet connector connected to a second Ethernet cable having an allocated global throttle wire directly connecting a plurality of block controllers within the rack with the management controller, wherein the block controllers within the IHS are pre-programmed to respond to an assertion of a signal on the global throttle wire by the management controller by immediately throttling operations of one or more of the IT gear.

2. The PMM of claim **1**, further comprising:

a backplane;

a plurality of connector receptacles mounted to the backplane;

a power supply circuit board mounted in each of the PSUs, the power supply circuit board received by and connected to one of the connector receptacles; and

a management controller circuit board mounted in each of the at least one management controller, the management controller circuit board received by and connected to one of the connector receptacles.

3. The PMM of claim **2**, wherein the power supply circuit board is inserted into a first connector receptacle with a first orientation and the management controller circuit board is inserted into a second connector receptacle with a second orientation, the first and second orientations being inverted relative to each other.

4. The PMM of claim **1**, further comprising:

at least one power bay busbar connected to the PSUs and positioned at the back of the PMM to electrically connect to one or more busbar segments to conduct electrical power from at least one of the plurality of PSUs to IT gear located adjacent to one of the one or more busbar segments, wherein the IT gear is configured with a power tap to electrically connect to a section of the adjacent bus bar segment and distribute received electrical power to IT gear components.

5. The PMM of claim **1**, wherein the chassis further comprises:

a plurality of walls enclosing at least one cavity; and

at least one cable routing channel extending through the chassis of the PMM for receiving one or more AC power cables.

6. The PMM of claim **5**, further comprising:

an AC switch box;

an AC power receptacle connected to each of the PSUs; and

at least one AC power cable routed through the cable routing channel and having a first end connected to the AC switch box and a second end connected to the AC power receptacle, the AC power cable supplying AC power from the AC switch box to the connected PSUs.

7. The PMM of claim **1**, further comprising:

at least one backup battery connected to the PSUs for supplying backup electrical power to the PSUs.

8. The PMM of claim **1**, further comprising:

a plurality of slideable rails located within the power and management bay and coupled to the chassis, the chassis adapted to be received by the slideable rails such that the PMM is moveable between a first extended position outside of the power and management bay and a second retracted position within the power and management bay.

9. The PMM of claim **1**, wherein the rack has a front side and a back side, the power and management bay being accessible from the back side, such that the IT gear can be

inserted to and made accessible from the front side of the rack, independent of and without interfering with access to the PMM from the back side of the rack.

10. An information handling system (IHS) comprising:

a rack having adjoined exterior frames that create a volumetric space for receiving a plurality of information technology (IT) gear and other functional components, the volumetric space including:

a plurality of IT gear slots each configured to receive at least one IT gear;

at least one power and management bay configured as a separate space from the IT gear slots; and

at least one power and management module (PMM) inserted into the at least one power and management bay, the PMM providing scalable power distribution and rack-level management functions that are shared by the plurality of IT gear inserted into the IT gear slots, wherein the PMM further comprises:

an infrastructure manager circuit board connected to the management controller by at least one Ethernet cable;

at least one Ethernet connector mounted to the infrastructure manager circuit board, the Ethernet connector facing toward a back side of the rack, the Ethernet connector connected to a second Ethernet cable having an allocated global throttle wire directly connecting each block controller within the IHS with the management controller, wherein the block controllers within the IHS are pre-programmed to respond to an assertion of a signal on the global throttle wire by the management controller by immediately throttling operations of one or more processing nodes within a respective block being controlled by the block controller.

11. The IHS of claim **10**, wherein the PMM comprises:

a plurality of power supply units (PSUs), wherein the number of PSUs is scalable based on the number of IT gear; and

at least one management controller that provides rack-level management of the IT gear and at least one associated block controller within the IHS.

12. The information handling system of claim **11**, the PMM further comprising:

a backplane;

a plurality of connector receptacles mounted to the backplane;

a power supply circuit board mounted in each of the PSUs, the power supply circuit board received by and connected to one of the connector receptacles; and

a management controller circuit board mounted in each of the at least one management controller, the management controller circuit board received by and connected to one of the connector receptacles.

13. The information handling system of claim **12**, wherein the power supply circuit board is inserted into a first connector receptacle with a first orientation and the management controller circuit board is inserted into a second connector receptacle with a second orientation, the first and second orientations being inverted relative to each other.

14. The information handling system of claim **12**, wherein the PMM further comprises:

a power controller coupled to the backplane, the power controller communicatively coupled to the PSUs, the at least one management controller and an infrastructure manager, the power controller controlling power functions of the PMM.

15. The information handling system of claim **11**, further comprising:

one or more busbar segments extending in a direction to intercept a rear of the IT gear inserted into the rack;

at least one power bay busbar connected to the PSUs and positioned at the back of the PMM to electrically connect to the one or more busbar segments to conduct electrical power from at least one of the plurality of PSUs to the IT gear inserted into the rack wherein the IT gear is configured with a power tap to electrically connect to a section of the bus bar segment and distribute received electrical power to the IT gear components.

16. The information handling system of claim **11**, wherein the PMM further comprises:

a housing defined by a plurality of walls, the housing enclosing at least one cavity; and

at least one cable routing channel extending through the housing of the PMM for receiving one or more AC power cables.

17. The information handling system of claim **16**, further comprising:

an AC switch box;

an AC power receptacle connected to each of the PSUs; and

at least one AC power cable routed through the cable routing channel and having a first end connected to the AC switch box and a second end connected to the AC power receptacle, the AC power cable supplying AC power from the AC switch box to the connected PSUs.

18. The information handling system of claim **16**, further comprising:

at least one backup battery connected to the PSUs for supplying backup electrical power to the PSUs.

19. The information handling system of claim **10**, wherein the rack has a front side and a back side, with the IT gear slots accessible from the front side and the power and management bay accessible from the back side, such that access to the processing nodes can be inserted to and made accessible from the front side of the rack independent of and without interfering with access to the PMM from the back side of the rack.

20. The information handling system of claim **10**, further comprising:

a plurality of slideable rails located within the power and management bay and extending between a front side of the rack and a back side of the rack, the PMM adapted to be received by the slideable rails such that the PMM is moveable between a first extended position outside of the power and management bay and a second retracted position within the power and management bay.

21. A method of constructing a rack-based information handling system, the method comprising:

configuring a rack having adjoined exterior frames that create a volumetric space for receiving a plurality of information technology (IT) gear and other functional components;

defining a plurality of IT gear slots within the volumetric space, each of the IT gear slots configured to receive at least one IT gear;

defining at least one power and management bay within the volumetric space configured as a separate space from the IT gear slots to receive at least one power and management module (PMM); and

mounting the at least one power and management module (PMM) into the at least one power and management

bay, the PMM providing scalable power distribution and rack-level management functions that are shared by the plurality of IT gear inserted into the IT gear slots, wherein the PMM comprises:

an infrastructure manager circuit board connected to the management controller by at least one Ethernet cable; and

at least one Ethernet connector mounted to the infrastructure manager circuit board, the Ethernet connector facing toward a back side of the rack, the Ethernet connector connected to a second Ethernet cable having an allocated global throttle wire directly connecting each block controller within the IHS with the management controller, wherein the block controllers within the IHS are pre-programmed to respond to an assertion of a signal on the global throttle wire by the management controller by immediately throttling operations of one or more processing nodes within a respective block being controlled by the block controller.

22. The method of claim **21**, further comprising:

mounting a plurality of power supply units (PSUs) into the PMM, wherein the number of PSUs is scalable based on the number of IT gear; and

mounting at least one management controller into the PMM, wherein the at least one management controller provides rack-level management of the IT gear and at least one associated block controller within the information handling system.

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